

**CPC****COOPERATIVE PATENT CLASSIFICATION****C21D**

**MODIFYING THE PHYSICAL STRUCTURE OF FERROUS METALS  
GENERAL DEVICES FOR HEAT TREATMENT OF FERROUS OR  
NON-FERROUS METALS OR ALLOYS  
MAKING METAL MALLEABLE BY DECARBURISATION, TEMPERING  
OR OTHER TREATMENTS** ( [cementation by diffusion processes C23C](#) ; [surface treatment of metallic material involving at least one process provided for in class C23 and at least one process covered by this subclass, C23F 17/00](#) ; [unidirectional solidification of eutectic materials or unidirectional demixing of eutectoid materials C30B](#) )

**Guide heading:**

- C21D 1/00**      **General methods or devices for heat treatments, e.g. annealing, hardening, quenching, tempering** ( [furnaces in general F27](#) ; [electric heating per se H05B](#) )
- C21D 1/02**      .    Hardening articles or materials formed by forging or rolling, with no further heating beyond that required for the formation
- C21D 1/04**      .    with simultaneous application of supersonic waves, magnetic or electric fields
- C21D 1/06**      .    Surface hardening
- C21D 1/08**      . .    with flames
- C21D 1/09**      . .    by direct application of electrical or wave energy  
                         by particle radiation
- C21D 1/10**      . . .    by electric induction
- C21D 1/18**      .    Hardening ( [C21D 1/02 takes precedence](#) )  
                         Quenching with or without subsequent tempering ( [quenching devices C21D 1/62](#) )
- C21D 1/185**      . .    { [from an intercritical temperature](#) }
- C21D 1/19**      . .    by interrupted quenching
- C21D 1/20**      . . .    Isothermal quenching, e.g. bainitic hardening
- C21D 1/22**      . . .    Martempering
- C21D 1/25**      . .    Hardening, combined with annealing between 300 degrees Celsius and 600 degrees Celsius, i.e. heat refining ("Vergüten")
- C21D 1/26**      .    Methods of annealing
- C21D 1/28**      . .    Normalising
- C21D 1/30**      . .    Stress-relieving
- C21D 1/32**      . .    Soft annealing, e.g. spheroidising
- C21D 1/34**      .    Methods of heating ( [C21D 1/06 takes precedence](#) )
- C21D 1/38**      . .    Heating by cathodic discharges
- C21D 1/40**      . .    Direct resistance heating
- C21D 1/42**      . .    Induction heating

- C21D 1/44 . . . in heat-treatment baths
- C21D 1/46 . . . . Salt baths
- C21D 1/48 . . . . Metal baths
- C21D 1/50 . . . . Oil baths
- C21D 1/52 . . . with flames
- C21D 1/53 . . . Heating in fluidised beds
  
- C21D 1/54 . . Determining when the hardening temperature has been reached by measurement of magnetic or electrical properties
  
- C21D 1/55 . . Hardenability tests, e.g. end-quench tests ( [investigating chemical or physical properties of materials in general G01N](#) )
  
- C21D 1/56 . . characterised by the quenching agents
- C21D 1/58 . . . Oils
- C21D 1/60 . . . Aqueous agents
- C21D 1/607 . . . Molten salts
- C21D 1/613 . . . Gases
- Liquefied or solidified normally gaseous material
  
- C21D 1/62 . . Quenching devices
- C21D 1/63 . . . for bath quenching
- C21D 1/64 . . . . with circulating liquids ( [in general F28D](#) )
- C21D 1/667 . . . for spray quenching
- C21D 1/673 . . . for die quenching
  
- C21D 1/68 . . Temporary coatings or embedding materials applied before or during heat treatment
- C21D 1/70 . . . while heating or quenching
- C21D 1/72 . . . during chemical change of surfaces
  
- C21D 1/74 . . Methods of treatment in inert gas, controlled atmosphere, vacuum, or pulverulent material ( [production of gases C01](#) , [C10](#) )
- C21D 1/76 . . . Adjusting the composition of the atmosphere
- C21D 1/763 . . . . { [using a catalyst](#) }
- C21D 1/767 . . . with forced gas circulation
- Reheating thereof
- C21D 1/773 . . . under reduced pressure or vacuum
  
- C21D 1/78 . . Combined heat-treatments not provided for above
- C21D 1/785 . . . { [Thermocycling](#) }
  
- C21D 1/82 . . Descaling by thermal stresses ( [mechanically B21](#) , [B23](#) ; [chemically C23](#) ; [electrolytically C25F](#) )
  
- C21D 1/84 . . Controlled slow cooling ( [cooling-beds for metal rolling B21B 43/00](#) )
  
- C21D 3/00      Diffusion processes for extraction of non-metals**

**Furnaces therefor** ( [local protective coatings C21D 1/72](#) ; [furnaces in general F27](#) )

- C21D 3/02 . Extraction of non-metals
- C21D 3/04 . . Decarburising
- C21D 3/06 . . Extraction of hydrogen
- C21D 3/08 . . Extraction of nitrogen
- C21D 3/10 . Furnaces therefor

**C21D 5/00 Heat treatments of cast-iron**

- C21D 5/02 . improving the malleability of grey cast-iron
- C21D 5/04 . of white cast-iron
- C21D 5/06 . . Malleabilising
- C21D 5/08 . . . with oxidation of carbon
- C21D 5/10 . . . . in gaseous agents
- C21D 5/12 . . . . in solid agents
- C21D 5/14 . . . Graphitising
- C21D 5/16 . . . . Packing agents

**C21D 6/00 Heat treatment of ferrous alloys**

- C21D 6/001 . { containing Ni ( [C21D 6/004](#) takes precedence ) }
- C21D 6/002 . { containing Cr ( [C21D 6/004](#) takes precedence ) }
- C21D 6/004 . { containing Cr and Ni }
- C21D 6/005 . { containing Mn }
- C21D 6/007 . { containing Co }
- C21D 6/008 . { containing Si }
- C21D 6/02 . Hardening by precipitation
- C21D 6/04 . Hardening by cooling below 0 degrees Celsius

**C21D 7/00 Modifying the physical properties of iron or steel by deformation** ( [apparatus for mechanical working of metal B21](#) , [B23](#) , [B24](#) )

- C21D 7/02 . by cold working
- C21D 7/04 . . of the surface
- C21D 7/06 . . . by shot-peening or the like

- C21D 7/08 . . . by burnishing or the like
- C21D 7/10 . . of the whole cross-section, e.g. of concrete reinforcing bars
- C21D 7/105 . . . { of concrete reinforcing bars }
- C21D 7/12 . . . by expanding tubular bodies
  
- C21D 7/13 . by hot working

**C21D 8/00** **Modifying the physical properties by deformation combined with, or followed by, heat treatment** ( hardening articles or materials formed by forging or rolling with no further heating beyond that required for the formation [C21D 1/02](#) )

- C21D 8/005 . { of ferrous alloys ( [C21D 8/02](#) to [C21D 8/12](#) take precedence ) }
- C21D 8/02 . during manufacturing of plates or strips ( [C21D 8/12](#) takes precedence )

**NOTE**

In this group classification is made according to the most important feature in one subgroup only; for other features indexing codes of [M21D](#) are added

- C21D 8/0205 . . { of ferrous alloys }
- C21D 8/021 . . { involving a particular fabrication or treatment of ingot or slab }
- C21D 8/0215 . . . { Rapid solidification; Thin strip casting }
- C21D 8/0221 . . { characterised by the working steps }
- C21D 8/0226 . . . { Hot rolling }
- C21D 8/0231 . . . { Warm rolling }
- C21D 8/0236 . . . { Cold rolling }
- C21D 8/0242 . . . { Flattening; Dressing; Flexing }
- C21D 8/0247 . . { characterised by the heat treatment }
- C21D 8/0252 . . . { with application of tension }
- C21D 8/0257 . . . { with diffusion of elements, e.g. decarburising, nitriding }
- C21D 8/0263 . . . { following hot rolling }
- C21D 8/0268 . . . { between cold rolling steps }
- C21D 8/0273 . . . { Final recrystallisation annealing }
- C21D 8/0278 . . { involving a particular surface treatment ( [C21D 8/0294](#) takes precedence ) }
- C21D 8/0284 . . . { Application of a separating or insulating coating }
- C21D 8/0289 . . . { Application of a tension-inducing coating }
- C21D 8/0294 . . { involving a localised treatment }
- C21D 8/04 . . to produce plates or strips for deep-drawing

**NOTE**

In this group classification is made according to the most important feature in one subgroup only; for other features indexing codes of [M21D](#) are added

- C21D 8/0405 . . . { of ferrous alloys }
- C21D 8/041 . . . { involving a particular fabrication or treatment of ingot or slab }

C21D 8/0415	....	{ Rapid solidification; Thin strip casting }
C21D 8/0421	...	{ characterised by the working steps }
C21D 8/0426	....	{ Hot rolling }
C21D 8/0431	....	{ Warm rolling }
C21D 8/0436	....	{ Cold rolling }
C21D 8/0442	....	{ Flattening; Dressing; Flexing }
C21D 8/0447	...	{ characterised by the heat treatment }
C21D 8/0452	....	{ with application of tension }
C21D 8/0457	....	{ with diffusion of elements, e.g. decarburising, nitriding }
C21D 8/0463	....	{ following hot rolling }
C21D 8/0468	....	{ between cold rolling steps }
C21D 8/0473	....	{ Final recrystallisation annealing }
C21D 8/0478	...	{ involving a particular surface treatment ( <a href="#">C21D 8/0494</a> takes precedence ) }
C21D 8/0484	....	{ Application of a separating or insulating coating }
C21D 8/0489	....	{ Application of a tension-inducing coating }
C21D 8/0494	...	{ involving a localised treatment }
C21D 8/06	.	during manufacturing of rods or wires
C21D 8/065	..	{ of ferrous alloys }
C21D 8/08	..	for concrete reinforcement
C21D 8/10	.	during manufacturing of tubular bodies
C21D 8/105	..	{ of ferrous alloys }
C21D 8/12	.	during manufacturing of articles with special electromagnetic properties

**NOTE**

In this group classification is made according to the most important feature in one subgroup only; for other features indexing codes of [M21D](#) are added

C21D 8/1205	..	{ involving a particular fabrication or treatment of ingot or slab }
C21D 8/1211	...	{ Rapid solidification; Thin strip casting }
C21D 8/1216	..	{ the working step(s) being of interest }
C21D 8/1222	...	{ Hot rolling }
C21D 8/1227	...	{ Warm rolling }
C21D 8/1233	...	{ Cold rolling }
C21D 8/1238	...	{ Flattening; Dressing; Flexing }
C21D 8/1244	..	{ the heat treatment(s) being of interest }
C21D 8/125	...	{ with application of tension }
C21D 8/1255	...	{ with diffusion of elements, e.g. decarburising, nitriding }
C21D 8/1261	...	{ following hot rolling }
C21D 8/1266	...	{ between cold rolling steps }
C21D 8/1272	...	{ Final recrystallisation annealing }

- C21D 8/1277 . . { involving a particular surface treatment ( [C21D 8/1294](#) takes precedence ) }
- C21D 8/1283 . . . { Application of a separating or insulating coating }
- C21D 8/1288 . . . { Application of a tension-inducing coating }
- C21D 8/1294 . . { involving a localized treatment }
  
- C21D 9/00** **Heat treatment, e.g. annealing, hardening, quenching, tempering, adapted for particular articles**  
**Furnaces therefor ( furnaces in general [F27](#) )**
  
- C21D 9/0006 . { Details, accessories not peculiar to any of the following furnaces ( control devices [C21D 11/00](#) ) }
- C21D 9/0012 . . { Rolls; Roll arrangements }
- C21D 9/0018 . . { for charging, discharging or manipulation of charge }
- C21D 9/0025 . . { Supports; Baskets; Containers; Covers }
  
- C21D 9/0031 . { Rotary furnaces with horizontal or slightly inclined axis }
- C21D 9/0037 . { Rotary furnaces with vertical axis; Furnaces with rotating floor }
  
- C21D 9/0043 . { Muffle furnaces; Retort furnaces }
  
- C21D 9/005 . { Furnaces in which the charge is moving up or down ( for wire, strip [C21D 9/54](#) ) }
  
- C21D 9/0056 . { Furnaces through which the charge is moved in a horizontal straight path ( [C21D 9/0043](#) takes precedence ) }
  
- C21D 9/0062 . { Heat-treating apparatus with a cooling or quenching zone }
  
- C21D 9/0068 . { for particular articles not mentioned below }
  
- C21D 9/0075 . { for rods of limited length ( of unlimited length [C21D 9/52](#) ) }
  
- C21D 9/0081 . { for slabs; for billets }
  
- C21D 9/0087 . { for chains, for chain links }
  
- C21D 9/0093 . { for screws; for bolts }
  
- C21D 9/02 . for springs
  
- C21D 9/04 . for rails ( apparatus for heat treatment of railway rails on the spot [E01B 31/18](#) )
- C21D 9/06 . . with diminished tendency to become wavy
  
- C21D 9/08 . for tubular bodies or pipes
- C21D 9/085 . . { Cooling or quenching }
- C21D 9/10 . . shotgun barrels
- C21D 9/12 . . barrels for ordnance
- C21D 9/14 . . wear- or pressure-resistant pipes

- C21D 9/16 . for explosive shells
- C21D 9/18 . for knives, scythes, scissors, or like hand cutting tools
- C21D 9/20 . for blades for skates
- C21D 9/22 . for drills  
for milling cutters  
for machine cutting tools
- C21D 9/24 . for saw blades
- C21D 9/26 . for needles  
for teeth for card-clothing
- C21D 9/28 . for plain shafts
- C21D 9/30 . for crankshafts  
for camshafts
- C21D 9/32 . for gear wheels, worm wheels, or the like
- C21D 9/34 . for tyres  
for rims
- C21D 9/36 . for balls  
for rollers
- C21D 9/38 . for roll bodies
- C21D 9/40 . for rings  
for bearing races
- C21D 9/42 . for armour plate
- C21D 9/44 . for equipment for lining mine shafts, e.g. segments, rings, props
- C21D 9/46 . for sheet metals
- C21D 9/48 . . deep-drawing sheets
- C21D 9/50 . for welded joints
- C21D 9/505 . . { Cooling thereof }
- C21D 9/52 . for wires  
for strips; { for rods of unlimited length }
- C21D 9/525 . . { for wire, for rods ( C21D 9/54 takes precedence ) }
- C21D 9/54 . . Furnaces for treating strips or wire
- C21D 9/56 . . . Continuous furnaces for strip or wire
- C21D 9/561 . . . . { with a controlled atmosphere or vacuum }
- C21D 9/562 . . . . { Details }

C21D 9/563	.....	{ Rolls; Drums; Roll arrangements }
C21D 9/564	.....	{ Tension control }
C21D 9/565	.....	{ Sealing arrangements }
C21D 9/567	....	with heating in fluidised beds
C21D 9/573	....	with cooling
C21D 9/5732	.....	{ of wires; of rods }
C21D 9/5735	.....	{ Details }
C21D 9/5737	.....	{ Rolls; Drums; Roll arrangements }
C21D 9/58	....	with heating by baths
C21D 9/60	....	with induction heating
C21D 9/62	....	with direct resistance heating
C21D 9/63	....	the strip being supported by a cushion of gas
C21D 9/64	...	Patenting furnaces
C21D 9/66	...	Tower-type furnaces
C21D 9/663	...	Bell-type furnaces
C21D 9/665	....	inverted or side-facing
C21D 9/667	....	Multi-station furnaces
C21D 9/67	....	adapted for treating the charge in vacuum or special atmosphere
C21D 9/673	....	Details, accessories, or equipment peculiar to bell-type furnaces
C21D 9/675	.....	Arrangements of charging or discharging devices
C21D 9/677	.....	Arrangements of heating devices
C21D 9/68	...	Furnace coilers hot coilers ( cold coilers <a href="#">B21C</a> )
C21D 9/70	.	Furnaces for ingots, i.e. soaking pits
<b>C21D 10/00</b>		<b>Modifying the physical properties by methods other than heat treatment or deformation</b>
C21D 10/005	.	{ by laser shock processing }
<b>C21D 11/00</b>		<b>Process control or regulation for heat treatments ( controlling or regulating in general <a href="#">G05</a> )</b>
C21D 11/005	.	{ for cooling }
<b>Guide heading:</b>		
<b>C21D 2201/00</b>		<b>Treatment for obtaining particular effects</b>
C21D 2201/01	.	Shape memory effect
C21D 2201/02	.	Superplasticity



- C21D 2201/03 . Amorphous or microcrystalline structure
- C21D 2201/04 . Single or very large crystals
- C21D 2201/05 . Grain orientation

**Guide heading:****C21D 2211/00      Microstructure comprising significant phases**

- C21D 2211/001 . Austenite
- C21D 2211/002 . Bainite
- C21D 2211/003 . Cementite
- C21D 2211/004 . Dispersions  
Precipitations
- C21D 2211/005 . Ferrite
- C21D 2211/006 . Graphite
- C21D 2211/007 . Ledeburite
- C21D 2211/008 . Martensite
- C21D 2211/009 . Pearlite

**C21D 2221/00      Treating localised areas of an article**

- C21D 2221/01 . End parts ( e.g. leading, trailing end )
- C21D 2221/02 . Edge parts
- C21D 2221/10 . Differential treatment of inner with respect to outer regions, e.g. core and periphery, respectively

**C21D 2241/00      Treatments in a special environment**

- C21D 2241/01 . under pressure
- C21D 2241/02 . . Hot isostatic pressing
- C21D 2241/03 . in zero gravity ( e.g. in spce )

**C21D 2251/00      Treating composite or clad material**

C21D 2251/02 . Clad material

C21D 2251/04 . Welded or brazed overlays

**C21D 2261/00      Machining or cutting being involved**

**C21D 2281/00      Making use of special physico-chemical means**

C21D 2281/01 . Seed crystals being used

C21D 2281/02 . temperature gradient